

Does Pepper Contribute to Food Preference?

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The effect of omitting pepper from certain foods is explored. Results of a comparison of natural pepper with imitation pepper are also reported.

Natural pepper became short in supply early in World War II when we were cut off from East Indian sources. Since the war the situation has improved somewhat, but natural pepper is still scarce and prices have remained high. During the war imitation peppers were introduced on the market and enjoyed a certain degree of success. In recent years the use of imitation peppers has increased rather than decreased until they are definitely a factor in the spice market. Also their potential importance to the food processing industries must be considered.

Imitation peppers appearing on the market have been highly variable in quality and it is probable that no formulation has been identical in flavor with natural pepper. This has emphasized the need for a method of evaluating imitation formulations both for their own flavor and for their effects on the flavor of foods.

Military interest in imitation peppers developed initially in relation to the problem of determining whether or not to stockpile natural pepper as a strategic material and also because of the difficulty of procuring the natural spice in sufficient quantity and the potential economic advantage of using the cheaper material. In 1948 the Qm. Institute initiated work on imitation peppers and pepper substitutes. During 1949 a method of evaluating imitations by sensory tests involving comparison with natural pepper was established (1). Available commercial imitations and a wide variety of experimental formulations were tested by this method. Every one was found to be definitely different from natural pepper in one or more aspects of flavor.

This work led to investigation of the basic importance of pepper as an improver of food flavors. Preliminary studies showed that pepper could be omitted from many foods where it is normally used with no loss of consumer preference and this finding suggested a re-orientation of our work. If natural pepper has little effect on food flavors as measured by consumer preference, the imitation pepper problem becomes less important. Then the consumer preference criterion would not be applicable and standards of performance for imitation peppers could be relaxed or else redefined.

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^b Presented before the Twelfth Annual Meeting of the IFT, June 12, 1952.

MATERIALS AND METHODS

The effect of pepper was studied only in foods where precedent would lead one to expect some beneficial effect. The foods tested were either processed items used in military rations or items prepared from recipes in the *Army Cook Book*. Pepper was required in each one either by recipe or by military specification. Foods were selected to include representatives of a number of food classes, including: soups, salads, vegetables, and processed meats. Emphasis was given to soups and canned meats on the basis of the results of a questionnaire submitted to representatives of the spice and food processing industries in 1949 since the respondents uniformly agreed that pepper is indispensable in such foods.

Flavor improvement was defined in terms of consumer preference. A food containing natural pepper at a certain concentration was compared with the same item prepared identically except that a flavorless pepper base was substituted for the pepper. The criterion of flavor improvement was a significant preference for the food containing pepper.

Two types of testing were employed:

- (a) Difference testing by the triangle method using a trained panel in order to determine whether or not pepper caused a flavor change and to estimate the amount of change.
- (b) Paired-comparison preference tests, using laboratory consumer groups drawn from among approximately 450 employees available within the Chicago Quartermaster Depot. The composition of the consumer groups varied randomly from day to day and both sexes were included. One-ounce samples of the 2 foods were presented simultaneously to the observer who was instructed to eat both and then indicate his preference. Each observer normally tried 2 pairs at a single test session, either repeating the test on a single pair or testing 2 pairs representing different concentrations of pepper in the same food.

The method of determining the concentration, or concentrations, of pepper to be tested on preference varied according to the accuracy of information available as to the use of pepper in the particular food. Three different situations were encountered:

- (a) *Processed items covered by military or industrial specifications.* The only pepper concentration tested was that given in the specification. Items with and without pepper were processed in parallel, the work being done either at the Institute or in cooperating industrial laboratories. Each "pepper" item was first tested for flavor difference against its "no-pepper" standard. If a difference was established, the pair was tested on consumer preference.
- (b) *Recipes stating a definite concentration of pepper.* The recipe concentration was tested for difference against the "no-pepper" food by the trained panel. If no definite flavor difference was found, the pepper concentration was increased to the point where approximately 67% correct responses were obtained on the triangle tests. This level was then tested on consumer preference against the "no-pepper" standard. If no definite preference was established but a trend toward preference for the "pepper" food appeared, the pepper level was adjusted upward or downward as required to determine whether the trend would become significant. Preference testing of an item was terminated whenever preference for the sample containing pepper had been established or when it was apparent that the testing of additional levels was unlikely to result in any increased preference.

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(c) *Recipes stating "pepper to taste."* The initial level for testing was determined by the judgment of trained home economists, and testing proceeded as in (b) above.

For foods where preference for the sample containing pepper was established, or where a trend in that direction was found, the investigation was extended to determine whether imitation pepper might have the same beneficial effect. Each food was prepared both with natural pepper and with imitation pepper at the optimum concentration and the two were compared on preference. The particular imitation pepper used was selected as meeting 2 criteria: (a) it was represented by its manufacturer as containing only domestically available materials and (b) it was closer to natural pepper in flavor, as determined by sensory testing in the laboratory, than any other imitation pepper which met the first criterion.

RESULTS

The results of the paired-preference comparisons for all of the foods tested are given in Table 1. Where tests on several concentrations were run, only the result showing the highest preference for the food containing pepper is shown. Pepper concentration is given as percent by weight of the food prior to cooking or processing where these steps were necessary as, for example, in soups or processed meats. When no cooking was involved, the pepper was added just before serving. The number of preference responses varied from 78 to 122 and no one made any given comparison more than twice.

The percentage preference for the "pepper" sample is shown and is evaluated in the last column. In the paired-preference test each sample would get 50% of the choices by chance alone if there were no preference for either sample. All differences between the obtained result and the chance result significant

TABLE 1

Results of paired preference comparisons between foods prepared with and without pepper

Foods	Percent Pepper ^a	N	Percentage Preference		Significance of Difference ^f
			With Pepper	Without Pepper	
Processed Meats ^c					
Bologna.....	0.375	82	62.2	37.8	5%
Frankfurters.....	0.375	80	52.5	47.5	.....
Salami.....	0.344	79	49.4	50.6	.....
Liver Sausage.....	0.250	80	61.2	38.8	5%
Beef and Gravy.....	0.045	80	55.0	45.0	.....
Corned Beef Hash.....	0.038	80	42.5	57.5	.....
Pork Sausage.....	0.130	122	58.2	41.8	10%
Soups ^d					
Split Pea.....	0.035	78	42.3	57.7	.....
Bean.....	0.048	78	65.4	34.6	1%
Cream of Potato.....	0.025	80	52.5	47.5	.....
Cream of Celery.....	0.031	81	53.1	46.9	.....
Chicken.....	0.020	80	66.2	33.8	1%
Bouillon.....	0.020	74	58.1	41.9	.....
Cream of Tomato.....	0.015	60	40.0	60.0	.....
Vegetable.....	0.010	80	66.2	33.8	1%
Salads ^d					
Cucumber and Onion.....	0.028	78	51.3	48.7	.....
Chopped Vegetable.....	0.063	80	54.8	45.2	.....
Potato.....	0.072	80	55.0	45.0	.....
Egg.....	0.100	80	42.5	57.5	.....
Vegetables ^d					
Lima Beans.....	0.030	78	53.8	46.2	.....
Peas.....	0.030	79	48.1	51.9	.....
Green Beans.....	0.030	78	39.7	60.3	.....
Creamed Carrots.....	0.020	79	58.2	41.8	.....
Others ^d					
Hashed Brown Potatoes.....	0.034	78	55.1	44.9	.....
Mashed Potatoes.....	0.040	80	51.2	48.8	.....
Creamed Chicken.....	0.030	80	53.8	46.2	.....
Fried Haddock.....	0.080	81	60.5	39.5	10%
Scrambled Eggs.....	0.055	80	58.8	41.2	.....
Tomato Juice.....	0.040	60	40.0	60.0	.....
Meat Loaf.....	0.303	80	52.5	47.5	.....
Hamburgers.....	0.220	60	51.7	48.3	.....

^a Pepper concentration determined by Military or Industrial Specifications.

^d Pepper concentration determined experimentally by adjusting recipes.

^c Percent pepper by weight prior to cooking or processing. When no cooking was involved, pepper added just before serving.

^f Level of confidence as determined by the "t" test.

below the 10% level of confidence are shown even though the latter can be regarded only as a slight trend.

Of the 31 foods and recipes tested, the addition of pepper increased preference in only 5. Only 2 classes were improved: bean, chicken, and vegetable soup all showed increased preference significant at the 1% level of confidence, and preference was increased at the 5% level of confidence in the 2 processed meats—bologna and liver sausage. In addition there were preference trends with pork sausage and fried haddock, but the other 24 foods gave no indication of increased preference. These 7 foods which were either improved by natural pepper or showed a trend toward improvement were studied further to compare the effects of natural pepper and the selected imitation pepper. Table 2 shows that the foods prepared with the 2 peppers were preferentially equal in all cases.

TABLE 2

Comparison of natural pepper with imitation pepper in foods which were improved by natural pepper

Foods	Percentage Pepper ^a	N	Percentage Preference		Significance of Percentage ^b
			Natural	Imitation	
Vegetable Soup	0.010	80	46.0	54.0	All results are insignificant
Chicken Soup	0.020	80	55.0	45.0	
Army Bean Soup	0.048	80	56.0	44.0	
Bologna	0.375	80	41.0	59.0	
Liver Sausage	0.250	80	50.0	50.0	
Pork Sausage	0.130	79	57.0	43.0	
Fried Haddock	0.080	80	45.0	55.0	

^a Percent pepper by weight prior to cooking or processing. When no cooking was involved, pepper added just before serving.

^b Level of confidence as determined by the "t" test.

DISCUSSION

The finding of no group preference for either of the 2 samples involved in each comparison might arise in two ways: first, the choices of all observers might be distributed by chance between the "pepper" and "no-pepper" samples, or some observers might actually prefer the "pepper" sample, being counterbalanced by an equal number who prefer the "no-pepper" sample. The frequent occurrence of the latter situation would be significant since it would mean that we were dealing with 2 opposing preference tendencies rather than a "no preference" situation. Since in many of the consumer tests each observer made 2 comparisons, the responses may be analyzed for consistency for an indication of the probable importance of opposite but equal preferences.

Table 3 presents the results of such an analysis for 14 foods where no preference was established and where the observers made duplicate comparisons. Those who chose the same sample each time, either "pepper" or "no-pepper," have been classed as "consistent" and those who chose different samples in the two comparisons have been classed as "inconsistent." If the choices of all observers had been determined by chance alone there would have been an equal number in each class. The significance of the difference between this chance percentage ratio and the observed ratio is shown. In only 3 of the 14 cases is the difference significant at the 5% level of confidence, which suggests that opposite but equal preferences were probably not a major factor.

What do the results of the experiment mean? Certainly they confirm the preliminary finding and lend strong support to the suggestion that the importance of pepper to the flavor of foods has been greatly over-emphasized. But when one doubts the efficacy of pepper,

TABLE 3

Consistency of individual preferences for foods with and without pepper when group preference is equal

Foods	Consistent Observers ¹		Inconsistent Observers ¹		Significance of Percentage ²
	N	%	N	%	
Potato Salad.....	28	70	12	30	1%
Creamed Carrots.....	26	68	12	32	5%
Pea Soup.....	27	66	14	34	5%
Mashed Potatoes.....	25	63	15	37	.....
Frankfurters.....	24	60	16	40	.....
Scrambled Eggs.....	23	58	17	42	.....
Green Beans.....	22	56	17	44	.....
Salami.....	21	54	18	46	.....
Chopped Vegetable Salad.....	21	53	19	47	.....
Cucumber and Onion Salad.....	19	49	20	51	.....
Meat Loaf.....	20	50	20	50	.....
Fresh Peas.....	19	49	20	51	.....
Hashed Brown Potatoes.....	18	46	21	54	.....
Lima Beans.....	17	44	22	56	.....

¹ Observers who chose either the "pepper" or "no pepper" sample twice in two comparisons.

² Observers who chose a different sample in each of the two comparisons.

³ Level of confidence as determined by the "t" test.

he is challenging a firmly entrenched tradition. Therefore it would be well to keep the record clear by stating what has not been proven.

These results are based on a laboratory technique and the consumers were drawn from the restricted population represented by 450 employees of the Chicago Quartermaster Depot. Quite obviously they could not be considered a satisfactory sample of the whole United States. Even though they were drawn from a metropolitan area and many factors would have been randomized, it is quite possible that other groups of people, possessing other national, regional, or cultural food habits, might have responded differently. Further, only a sampling of the many common foods in which pepper may be used was tested. By chance the experiment may have neglected a significant number of those recipes where pepper is important. Certainly there are many specialty dishes which were not considered. The results are not concerned with individual preferences but only with the group response. Thus, they do not deny the validity of the gourmet's demand for the special flavor quality that only natural pepper can provide. Sometimes it is claimed that the beneficial effects of spices lie as much in preventing monotony of a diet over periods of continued use as in the immediate enhancement of preference. Such long term effects were not investigated.

Once we have clearly expressed the limitations of the data we may seek out their positive implications. These are not negligible. Although the experiment included only 31 foods, they represented several flavor types and were common foods where custom requires the use of pepper. That similar effects would have been found in many other foods is unquestionable. Preference was tested under conditions of laboratory control where any real effect would have been enhanced rather than minimized. The significance of a preference established under such conditions may be denied on the grounds that it is based on factors which would not be noticed

under non-laboratory conditions. However, a finding of "no-preference" can not be challenged on the same grounds since one is even more likely to find the same effect under conditions of normal consumption. Further, even though the group from which the observers were drawn cannot be considered representative of the entire American consumer population, one should not overlook the possibility that it is representative of large segments of that population. There is no obvious reason why the flavor preferences of residents of the Chicago area will be different from those of Americans in the mass. The selection processes which brought people, first to the Chicago Quartermaster Depot and then to the laboratory, were not such as to bias any data on food preferences. Thus the results can claim to be somewhat more than suggestion.

No matter how valid the finding that natural pepper is unimportant in determining preference for foods as eaten, the demand for pepper—both by consumers and by food processors in the supposed interests of consumers—is a self-evident fact. Further, there is evidence that imitation peppers have been relatively ineffective in satisfying the demand. This seems inconsistent. How does one explain this demand? The question cannot be answered here but can be put into perspective by reference to the concept of habit. Pepper continues to be in demand in large part because our culture has developed habits of preparing food and eating food wherein pepper is included. For many people pepper may be more important as a symbol than as a flavor. Its removal or its significant alteration as in imitation peppers may affect flavor but little and preferences not at all, but still may violate our sense of propriety.

Research results such as these probably have but little significance in regard to pepper on the direct consumer market. The consumer's habits change quickly only through dire necessity. But the results seem to have at least two important implications for the food processor who may be faced with pepper shortages and high prices. These possibilities are:

- that pepper may be entirely omitted from certain foods without loss of consumer acceptance, and
- that imitations may be substituted for natural pepper in many other foods without loss of acceptance.

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LITERATURE CITED

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